PEAR GROWING in the PACIFIC COAST STATES

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PEAR GROWING in the PACIFIC COAST STATES

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About 80 percent of the pear crop of the United States is produced in the 3 Pacific Coast States. Production there averages about 25 million bushels annually. Varieties mainly of high quality and European origin are grown. The pear areas are characterized by dry summers with abundant sunshine. In the better orchards 30 tons of fruit per acre is sometimes produced. The bacterial disease known as blight (fire blight, pear blight), which makes it necessary to grow partly resistant varieties in most parts of the United States, can be controlled well enough on the Pacific coast to permit growing very choice varieties, even though they are susceptible.

CLIMATIC REQUIREMENTS OF PEARS

Although pears will stand a wide range of climatic conditions, their culture has been restricted mostly to areas that are particularly favorable for them. On the Pacific coast pears are an important commercial crop from south-central California up into British Columbia. The southern limit of commercial pear growing is determined by the prevalence of high winter temperatures. The commercial pear varieties grown on the Pacific coast require a considerable period of low temperatures (about 1,200 hours under 45° F.) during the winter months to permit them to complete their dormant period and to start off vigorously in the spring. Therefore, pears are not adapted for commercial production in sections where winter temperatures are so mild that the trees do not complete this period before blossoming time.

Most varieties of pears can stand fairly low winter temperatures without much injury. If the trees are fully dormant, temperatures as low as –20° F. usually do little injury. The wood and buds of pears seem more subject to injury from low temperatures than do those of apples under the same conditions. On the other hand, pears are slightly more resistant to low temperatures than are peaches. In general, pear planting is considered questionable where temperatures lower than –20° to –25° are likely to occur.

In most Pacific coast sections irrigation is depended on for moisture, the main exceptions being in northwestern Oregon and western Washington; consequently, rainfall does not determine the distribution of pear production. Where natural rainfall is depended on for soil moisture, an average of at least 35 inches per year is desirable.

Air drainage and freedom from spring frosts are very important in the location of a pear orchard. Pears are relatively early bloomers. If the rest period has been completely broken during the winter, pears normally bloom several days before apples. The blossoms are about as easily damaged by spring frosts as are those of apples and peaches. Temperatures of 26° F. or lower will generally kill the open

[1] The previous edition was prepared by C. F. Kinman (retired) and J. R. Magness.

blossoms. Therefore, because of the earlier blooming season the hazards from spring frosts are greater with pears than with apples. In some parts of the Pacific Northwest pear orchards are equipped with heaters to protect the trees during the blooming season, particularly where orchards are located on lowland where air drainage is not especially good. Because of the adaptation of pears to fairly heavy soils, orchards have frequently been located on lowland.

The most serious disease in pear production is blight, caused by a bacterium. On the Pacific coast this disease is most serious in the interior valleys, particularly those of California and southern Oregon, where spring and early-summer temperatures are likely to be high. In sections having cooler growing seasons, such as the coastal districts of California, the Willamette and Hood River Valleys of Oregon, and the Puget Sound section of Washington, pears are much less seriously affected by this disease.

The climate has a definite effect on the quality of certain varieties. The Bartlett, which is the most important pear variety on the Pacific coast, apparently reaches its highest dessert and best shipping and storage qualities where temperatures are high for the 2 months preceding harvest. When grown in hot sections, this variety ripens more slowly after harvest, remains in prime eating or canning condition longer, and has less tendency to break down at the core than when it is grown in cooler sections. The Bosc, another important variety, also appears to reach its highest dessert quality where temperatures are high. The Comice, Hardy, and Winter Nelis are well suited to cooler conditions and appear to reach equally good quality in the cooler climate of the coastal districts of California and the moderately hot valleys of the Northwest.

The mean summer temperatures at typical points in important Pacific coast pear sections are shown in table 1.

TABLE 1.—*Mean growing-season temperatures, by months, in important pear-growing sections in the Pacific Coast States*

State and section	Station	Mean temperatures in—						
		March	April	May	June	July	August	September
		° F.	° F.	° F.	° F.	° F.	° F.	° F.
California:								
Antelope Valley	Fairmont	52. 1	57. 0	63. 9	72. 3	80. 9	79. 8	73. 0
Central	Auburn	51. 2	56. 1	62. 4	71. 4	77. 0	76. 0	69. 2
	Marysville	54. 3	59. 4	64. 8	72. 8	77. 8	76. 2	71. 9
	Sacramento	54. 3	58. 1	63. 3	69. 4	73. 2	72. 9	69. 3
	Upper Lake	49. 9	54. 8	59. 6	66. 7	73. 8	72. 7	66. 7
Central, coastal	San Jose	53. 1	56. 3	58. 5	62. 7	66. 5	66. 1	64. 2
	Santa Rosa	51. 2	54. 4	57. 6	63. 0	65. 2	64. 4	63. 8
Oregon:								
Hood River Valley	Hood River	43. 3	49. 9	56. 1	61. 6	67. 4	66. 6	59. 5
Rogue River Valley	Medford	46. 7	51. 6	57. 7	65. 2	71. 8	70. 8	63. 1
Washington:								
Puget Sound	Puyallup	44. 8	49. 2	54. 2	59. 6	63. 8	62. 8	57. 7
Wenatchee Valley	Wenatchee	42. 8	51. 5	58. 8	66. 2	73. 2	71. 6	61. 6
Yakima Valley	Yakima	44. 1	52. 5	59. 0	66. 4	71. 4	69. 5	61. 1

SOILS FOR PEARS

Pears will grow well on a wider range of soils than most other orchard fruits. The trees will thrive on practically all orchard soils provided they have enough moisture and are well drained. Pears will do better on the heavy, sticky clays and adobe soils than almost any other commonly grown fruit. However, they grow best on a deep, fertile clay loam with a well-drained subsoil.

Where irrigation is not supplied, it is particularly important that the soil be deep, with good capacity to hold moisture. The summer in all the Pacific coast sections is relatively dry. If the soil is not able to hold a large amount of available moisture, the trees will suffer as they grow older unless irrigation is practiced. With deep retentive soils, fairly good production can be had without irrigation if the winter rainfall is abundant.

PEAR-GROWING AREAS

Most orchards in the Pacific Coast States are in restricted sections where conditions are especially good for production. The prevalence of blight has prevented a more general distribution of pear growing in some sections. All three Pacific Coast States have important pear-growing areas, which are widely separated. Each possesses peculiarities that make pear growing attractive. These areas are as follows: (1) Interior valleys of central California, including the smaller tributary valleys and adjacent slopes and foothills; (2) coastal sections of central California; (3) Rogue River Valley of southwestern Oregon; (4) Hood River Valley of north-central Oregon; and (5) Yakima and Wenatchee Valleys of central Washington.

The acreage devoted to pears in the principal pear-growing sections is given in tables 2–4.

TABLE 2.—*Acreage of pears in California in major producing counties and total acreage for the State, 1953* [1]

County	Bearing trees	Nonbearing trees	Total
	Acres	*Acres*	*Acres*
Placer	5, 249	1, 768	7, 017
Santa Clara	6, 276	634	6, 910
Sacramento	4, 225	291	4, 516
Lake	3, 803	461	4, 264
El Dorado	3, 888	65	3, 953
Solano	2, 584	136	2, 720
Mendocino	2, 106	135	2, 241
Contra Costa	2, 068	59	2, 127
Sonoma	1, 785	156	1, 941
Others	6, 821	463	7, 284
Total	38, 805	4, 168	42, 973

[1] BLAIR, R. E., and FRIESEN, HARRY. CALIFORNIA FRUIT AND NUT CROP ACREAGE ESTIMATES AS OF 1953. Calif. Dept. Agr. Bul. 43: 77–104. 1954.

TABLE 3.—*Acreage of principal varieties of pears in California, 1953* [1]

Variety	Bearing trees	Nonbearing trees	Total
	Acres	*Acres*	*Acres*
Bartlett	34, 147	3, 878	38, 025
Hardy	1, 894	168	2, 062
Winter Nelis	818	4	822
Comice	694	40	734
Bosc	519	6	525
Others	733	72	805
Total	38, 805	4, 168	42, 973

[1] See footnote 1, table 2.

TABLE 4.—*Estimated acreages of pears in principal producing areas of Oregon and Washington, 1954*

Variety	Jackson County, Oreg.[1]	Hood River County, Oreg.[2]
	Acres	*Acres*
Bartlett	4, 000	3, 600
Anjou	2, 600	2, 670
Bosc	2, 000	200
Comice	850	100
Others	600	100
Total	10, 050	6, 670
	Yakima Valley, Wash.[3]	North-central Wash.[4]
	Acres	*Acres*
Bartlett	11, 700	4, 190
Anjou	1, 550	2, 160
Bosc	470	60
Others	280	30
Total	14, 000	6, 440

[1] Estimates supplied by county agricultural agent, C. B. Cordy.
[2] Calculated from records of Hood River Apple Growers Association.
[3] Calculated from data supplied by Agricultural Marketing Service on basis of 80 trees per acre.
[4] Calculated from data in The 1954 Fruit Tree Survey in North Central Washington by Emery C. Wilcox. Wash. Agr. Expt. Stas. Cir. 270, 42 pp. 1955.

Outline maps of California, Oregon, and Washington (figs. 1–3) show the relative position of the pear-growing centers.

FIGURE 1.—Distribution of pear growing in California. Each dot represents 100 acres of pears.

INTERIOR VALLEYS OF CENTRAL CALIFORNIA

Pear culture in the interior valleys of central California is mainly restricted to a few sections, but commercial orchards are scattered throughout almost the whole area. Nearly half of the pear trees in California are growing in this area. The principal pear-producing sections here include (1) the bottom lands of the Sacramento Valley, (2) the foothills east of the Sacramento Valley, (3) the valleys northwest of the lower Sacramento Valley, and (4) the Clear Lake district of Lake County and the Ukiah district of Mendocino County. All are desirable for the production of the Bartlett variety.

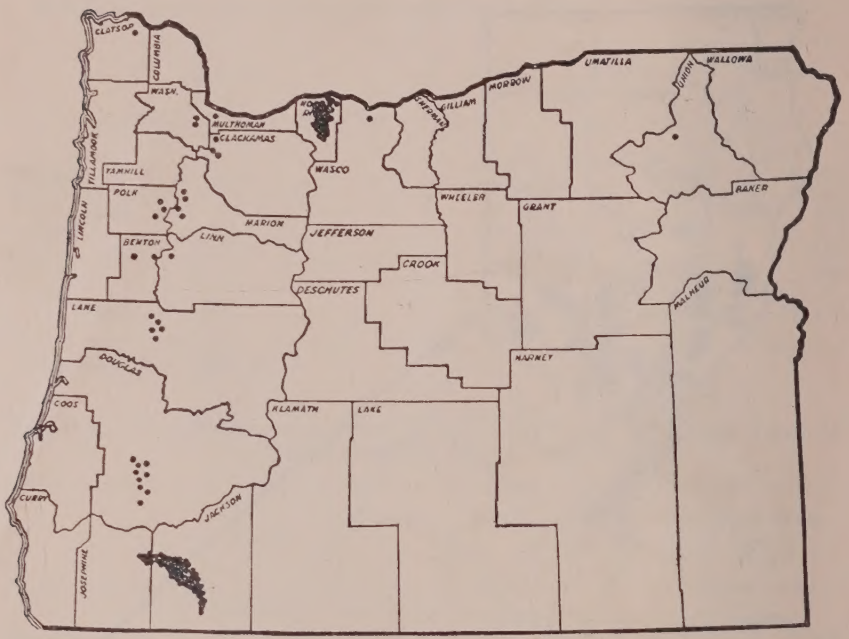

FIGURE 2.—Distribution of pear growing in Oregon. Each dot represents 100 acres of pears.

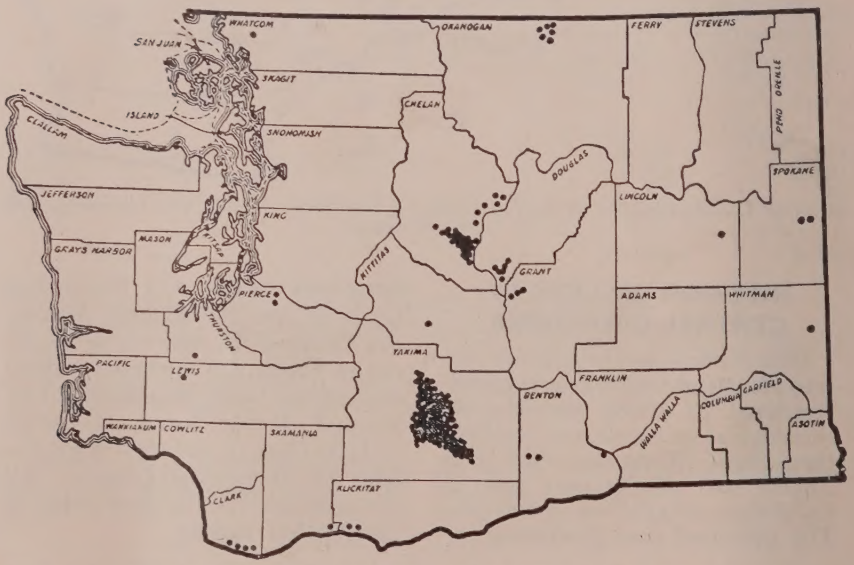

FIGURE 3.—Distribution of pear growing in Washington. Each dot represents 100 acres of pears.

Bottom Lands of the Sacramento Valley

The bottom lands of the Sacramento Valley constitute one of the most important pear-growing sections of the Pacific slope. Between the cities of Sacramento and Isleton pear culture is the most important fruit industry. Practically all the pear trees in this section are near the river (fig. 4).

The soils devoted to pear culture are largely sedimentary and of recent origin, having been deposited over a layer of peat. In some places the overflow from the river has added to the depth of the soil since the early orchards were established. Levees now prevent the river from overflowing. The soil is a dark, open, friable, warm loam. The Bartlett, which is grown almost to the exclusion of other varieties, produces excellent fruit here both for dessert and for canning.

All orchards of this section are equipped for irrigation. Water from the river is easily and cheaply obtained by means of pumps beside the river and pipes through the river levees.

As in most other sections of California where pears are grown, the coldest weather brings frequent frosts but only occasional light freezes. A large part of the pear-producing section lies within the area where summers are moderately hot, although tempered to some extent by cool breezes from San Francisco Bay.

Pears in this section mature early, the first Bartlett shipments from the State usually originating here. The first shipments normally are made early in July, and the fruit moves to eastern markets for approximately 6 weeks. A large part of the late-harvested fruit is canned.

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FIGURE 4.—Old Bartlett pear trees in the lower Sacramento River Valley that had much of their annual growth pruned off during the winter.

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Foothills East of the Sacramento Valley

In the foothills east of the Sacramento Valley about 12,000 acres of pears are in Placer, El Dorado, and Nevada Counties. The highest elevation of the pear orchards is about 3,500 feet. The Bartlett is by far the most important variety. The fruit reaches high dessert quality and attains a more colorful red blush than is common in most other districts. It ships well to market. On hillsides or where the soil is not deep, the fruit is usually smaller than that from orchards on the deep soils of the river bottoms. Pears from lower elevation orchards ripen about the same time as the river pears of the same varieties. The harvest in the higher orchards is considerably later; therefore, fruit from these orchards has an advantage in arriving on the market after peak shipments are past. The Bosc, Winter Nelis, and other winter pears are minor commercial varieties in this section, grown mainly as pollinizers for the Bartlett.

Most of the trees on the poorer soils of this section are not large, and the yield is not so heavy as on the deep bottom lands. Because of the late ripening of the fruit, its high shipping and dessert qualities, and excellent appearance, much of the output is shipped fresh, but some of it is canned. All the orchards are irrigated.

Much of the soil in this section is derived from the weathering of granite bedrock and is open, easily worked, fertile, and well drained, but it is low in organic matter. It is several feet deep in some places; in others it is shallow, and outcroppings of granite are common. After rains and irrigations the drainage water from the higher soils accumulates at low levels in areas varying in size up to several acres. Too much soil water accumulates for the satisfactory growth of most orchard trees. Many of these areas are planted to pears; in others, especially in the higher parts, pear growing is the main industry, the deepest and best soils being used for this purpose. In the Placerville-Camino district of El Dorado County pears are planted mostly on Aiken clay loam, a residual soil from disintegrating schist rocks. It is red, friable, and of good depth and contains a moderate amount of organic matter.

The summers are generally hot but somewhat shorter than along the Sacramento River or in the districts lower in the foothills, and the pear blossoms are sometimes injured by frost.

Valleys Northwest of the Lower Sacramento Valley

A third section of the interior valleys of central California includes the Vaca Valley, northwest of the lower Sacramento River Valley, and the district near Fairfield, both in Solano County. Around Fairfield the summer temperatures are more like those of the coastal section. Little water is available for irrigation. The Bartlett is the principal variety, and most of the fruit is shipped fresh.

In the Vaca Valley the summers are hot and advance rapidly. The soil is a very deep, fertile, friable loam, and the trees are thrifty, but on account of lack of moisture they do not grow rapidly, and the tonnage of fruit produced is only moderate. The slow growth provides unfavorable conditions for blight development. Some of the pear orchards are old and there are but few new plantings, as most of the available orchardlands in this valley have been planted.

Clear Lake District of Lake County and Ukiah District of Mendocino County

The fourth section of pear production in the interior valleys of central California includes the Clear Lake district around Kelseyville and Upper Lake, both in Lake County, and the Ukiah district in Mendocino County. In some places the soil is a deep and easily tilled loam, but generally it is a rather heavy black clay that gradually slopes to the level of the lake. It is very fertile but should be worked only at the proper time. More and more orchards are being irrigated. The water is obtained largely from wells.

The Bartlett is grown practically to the exclusion of other varieties (fig. 5). Trees grow well and bear regularly. The fruit is large, of good quality, and an attractive color. It ripens later than in the principal pear sections of the Sacramento Valley. Consequently, it reaches the market after the heavy shipments from those sections have been sold. The fruit attains excellent shipping quality because of the high temperatures. Most of the crop is shipped fresh or sent to canneries.

A part of the crop in the Clear Lake district is dried. Because of the hot, dry summers the fruit matures evenly so that it does not break down in the center upon ripening and the fruit can be dried in the open inexpensively. Dried pears from Lake County are the standard of excellence for this product owing to their large size and high quality.

COASTAL SECTIONS OF CENTRAL CALIFORNIA

The principal pear-growing sections between the Coast Ranges and the Pacific Ocean in California are the low coastal plains adjoining San Francisco Bay in Santa Clara, Alameda, and Contra Costa Counties; the Napa Valley of Napa County; and the Sonoma Valley of Sonoma County. The temperatures are much lower than in the interior valleys because of the ocean breezes. As a result, blight is less likely to

40034–P

FIGURE 5.—A 40-year-old Bartlett pear orchard with trees 40 feet apart in Lake County, Calif. Such trees bear heavy crops of fruit.

develop and the fruit ripens later. The Bartlett is of less desirable quality for distant shipping than in sections where there are a few weeks of high temperatures before harvest.

This area is one of the oldest centers of commercial pear culture in California. Some of the orchards planted in the middle of the 19th century are still cultivated, though many varieties planted then have been grafted to more desirable ones. More varieties are grown commercially in this area than in other parts of California. They include the Bartlett, Hardy, Winter Nelis, Bosc, Anjou, Easter Beurre, Clairgeau, and Comice. The Bartlett and Hardy are the most popular for planting. The Bartlett is grown mostly for canning and the later ripening varieties are shipped fresh.

Many of the pear orchards near San Francisco Bay are at a low elevation. The soil is a dark moderately heavy clay that is fertile but sticky when wet and hard when dry. It must be worked only when it is in proper condition. Farther back from the bay and on higher elevations the soil becomes more loamy and open and is well adapted to the culture of other deciduous fruits and nuts. Occasional pear orchards have been planted on this more loamy land also, and they generally have good tree growth and production. Practically all the orchards of this section are irrigated. Santa Clara County ranked second in total pear acreage in California in 1953 with 6,910 acres.

Near San Juan Bautista and in the Carmel Valley in Monterey County, pears are the principal fruit grown, but the acreage is not large. In the former locality the soil is deep, fertile, and rather heavy, and excellent tree growth and fruit production are obtained. The late-ripening varieties are grown almost exclusively, and the fruit is shipped fresh. (Fig. 6.) The pear-growing center in Carmel Valley is a narrow strip of river bottom land a few miles inland from the ocean. The soil is a deep, fertile, open loam, and trees thrive and bear well. Late-ripening varieties are principally grown.

43221-P

FIGURE 6.—A 10-year-old Hardy pear orchard of trees on quince roots, planted 24 by 24 feet apart, near San Juan Bautista, Calif. (Photographed in April.)

Throughout this coastal area, as well as in the more southern sections of California, the Bartlett pear tends to lose its characteristic long shape. Under extreme conditions the radial diameter of the fruit almost equals its length, and the fruit is less desirable for canning. This condition constitutes a serious problem in coastal sections where the crop is largely used for canning. Tufts and Hansen [2] have shown that fruit from the more northern sections averages longest in proportion to diameter, the ratios varying from about 1.2 to 1 in central California to about 1.48 to 1 in Yakima, Wash.

ROGUE RIVER VALLEY OF OREGON

The principal pear plantings in western Oregon are in the Rogue River Valley, although there are limited plantings in the Umpqua and Willamette River Valleys. The Rogue River Valley area, lying west of the center of the State and almost touching the California line, has more than 10,000 acres of pears. It ranges from 1,874 feet above sea level at Ashland on the south to 935 feet at Grants Pass on the north and is almost entirely surrounded by mountains. Medford is the principal shipping point. Large plantings were made early in this century, although about half of the present acreage has been planted since water for irrigation was made available between 1917 and 1920. The ravages of blight have been very severe in this valley.

Freezing temperatures occur throughout the Rogue River Valley in winter. Spring frosts are frequent, particularly on the floor of the valley, and orchards must be protected by heating, which is general and efficient. The lower slopes surrounding the valley seldom have damaging frosts during blossom-time because of good air drainage. The summers are hot, dry, and favorable for the ripening of pears. The rainfall from September to the following May totals 15 to 25 inches per year and is supplemented by irrigation during the dry season in all but a small percentage of the orchards.

Much of the soil of this section is a rather heavy adobe, and it is better suited to pears than other fruits. Although the soil is fertile, much of it is underlain by a stratum of hardpan, at a depth varying from a few inches in some of the uplands to several feet in the bottom lands. In parts of the Rogue River Valley a high water table presents a serious problem, requiring community drainage efforts. On the deeper soils trees grow rapidly; on the shallower ones growth is rather slow. The slow-growing trees are less susceptible to blight, but production is also much less.

The Bartlett, Anjou, Bosc, and Comice are the varieties most extensively planted. The Bartlett is the most important, and recent plantings have been largely of this variety, Anjou, and Comice. The Bartlett produced here has high dessert and canning qualities and ships well. Most Bartlett orchards are in bearing. The Bosc blights badly here, but it bears heavily, and the fruit is of good size, quality, and appearance. The Anjou is popular because of its excellent size, appearance, and dessert and storage qualities. It is the most blight resistant of the varieties extensively grown (fig. 7).

In the Umpqua and Willamette River Valleys pears are grown commercially, but they are not among the most important fruits. Summer temperatures are lower than in the Rogue River Valley and not

[2] Tufts, W. P., and Hansen, C. J. Variations in shape of Bartlett pears. Amer. Soc. Hort. Sci. Proc. (1931) 28: 627–633. 1932.

50057–P

FIGURE 7.—A typical Anjou pear orchard on adobe soil, Medford, Rogue River Valley, Oreg. (Photographed in July.)

warm enough for the best development of most pear varieties. Because of the lower temperatures there is almost no loss from blight. Winter injury has at times been serious in the Willamette Valley, causing the loss of many orchards.

HOOD RIVER VALLEY OF OREGON

The Hood River Valley, about 120 miles from the coast and at the extreme northern boundary of Oregon, is an important pear-growing area. The Anjou and Bartlett are the principal varieties grown (table 4). The Bartlett is used mainly for canning, with some fresh-fruit shipment.

The soils of this area vary considerably in depth and texture but not sufficiently to restrict the planting to given soil types. Pear orchards are scattered throughout the fruit-growing part of the valley. Most of the surface soils are sandy or silty loam, very open, and in many places rather shallow. Water passes through these soils rapidly. The subsoils are composed of about the same materials as the upper soils in many places. Some of the subsoils are very open, permitting good or sometimes excessive drainage; others are so compact that downward movement of water through them is slow.

The rainfall during the summer is light, and practically all orchards are irrigated. With the very open and well-drained soils in one locality and compact subsoils in another, careful observation and caution are necessary in adopting a successful irrigation program. Although the roots of pear trees can stand excessive soil moisture better than the roots of many other fruit trees, they will not thrive in water-logged soils in the summer. Therefore, where a hard substratum comes too near the surface, care in drainage is necessary to prevent an accumulation of seepage water from higher levels.

As the soil has a high sand and silt content and the surface layer

suited to root growth is shallow in some places, the humus content needs to be increased and maintained. Cover crops, either cultivated plants or native vegetation, are grown for this purpose in most orchards. Alfalfa and sweetclover are the crops most commonly used.

Winter injury constitutes a greater hazard to pear production in this area than in other important pear areas of the Pacific coast. Winters are generally mild, but occasional severe cold weather when the trees are not thoroughly hardened has resulted in serious damage, particularly to young trees. Blight has not been serious in the Hood River Valley.

VALLEYS OF CENTRAL WASHINGTON

Two irrigated sections, one the Yakima River Valley and the other along the Columbia and Wenatchee Rivers centering about Wenatchee, are the important pear-producing areas of Washington. Pear orchards are scattered throughout these large fruit-growing belts. In the older orchards pears and apples were often interplanted. In both sections the soil is generally deep, fertile, and well suited to pear growing. As the rainfall is very sparse and occurs during the winter, all orchards are irrigated. Blight, although troublesome in some years, is not so severe as in the Rogue River Valley and the interior-valley sections of California. For acreages and varieties of pears grown, see table 4.

In both the Yakima and Wenatchee sections the Bartlett attains good size, shape, and quality for canning. The fruit reaches the extreme length in proportion to width in these northern sections, a shape very popular for canning. With abundant cold-storage facilities in the area, much of the Bartlett crop is held in cold storage and sent to canneries when they want it. Some of it is placed on the fresh-fruit market after the California movement is over.

Since 1950 many pear trees in both these sections have not grown well, the cause of which is not known. Severe winter temperatures may be a factor. Intensive research is under way to determine the cause of this "pear tree decline."

SITES FOR PEAR ORCHARDS

From the standpoint of air drainage for frost protection, the slopes of rolling lands are preferable for pears; but for the purpose of crop diversification these places are often planted, in California at least, to fruits that blossom earlier than pears and are therefore more susceptible to frost injury at blossom-time. Consequently, the lower sites are planted to pears, where artificial frost-prevention practices are sometimes necessary. The slopes also afford better soil drainage, but pears are more resistant to faulty growing conditions than are other fruits and will endure considerably more soil moisture provided it is not stagnant and the soil is fertile.

Although pears do best in a deep soil, they will often grow where the water table is too high for most other deciduous fruits. In the principal pear-growing areas of California and Oregon, many pear trees have been planted on sites where, at least during the winter and spring, the soil moisture exceeds that considered ideal for the best tree growth.

STOCKS USED IN PROPAGATING PEAR TREES

Extensive studies have been made to determine the most suitable rootstocks for propagating pear trees. The most widely used stock has been the European wild pear (*Pyrus communis* L.), commonly called French pear. It is a vigorous grower, withstands both drought and excessive soil moisture exceedingly well, and is satisfactory on a wide variety of soils. It is also resistant to oak-root fungus. However, this species is very susceptible to blight. It often produces suckers, thereby providing a convenient entrance to the root for blight. Large numbers of suckers often appear well out under the branches, as well as near the trunk. The common practice is to remove this growth each year in order to reduce the chances for blight infection. Except where dwarf trees for close planting are desired, the French stock appears to be excellent for general planting, even though it is susceptible to blight.

Since World War II nurserymen have largely used Bartlett seedlings for propagating pears, assuming that they will be as satisfactory as the French seedlings.

For several years the Japanese stock *Pyrus pyrifolia* (Burm.) Nakai, synonym *P. serotina*, was planted extensively because of its resistance to blight and woolly apple aphid and also because of its vigorous growth on open, well-drained soils. It is considerably more resistant to blight than the French species. However, its use has been discontinued. It was unsatisfactory when planted on sandy, heavy, wet, or shallow soil (fig. 8), where the fruit developed black end, or

43351–P

FIGURE 8.—A Bartlett pear orchard on very heavy adobe soil, Kelseyville, Calif. The two large trees, which are on French pear roots, stand out from the other trees, which are on Japanese pear roots. (Photographed in June.)

hard end, which has been disastrous to many orchards, especially in California. The apex of the pear becomes deformed and blackened, and consequently the fruit is unsalable. Black end has appeared almost exclusively on trees with Japanese roots. On soils that are not satisfactory for good tree growth, the loss from black end is often more pronounced than on open, fertile soils, on which the trees grow well. Black end has caused the removal of many orchards in California and considerable loss in the Northwest.

Other oriental pear stocks, such as *Pyrus calleryana* Dcne. and *P. ussuriensis* Maxim., have been used in several orchards. The seedlings of the former are being tested by some orchardists and experimenters. The suitability of *P. calleryana* for cold areas is questionable, as it is more subject to winter injury than the French root. The planting of *P. ussuriensis* has been discontinued, because it was not immune from blight and black end on the fruit was prevalent.

Where the soil is shallow but otherwise suited to pear culture or where close planting or early fruiting is desired, quince stock is used, as it has a dwarfing effect on the top. Since trees on this stock fruit early and more may be planted per acre than if standard stocks were used, heavier yields per acre may be expected for several years. The semidwarfing of the trees, causing early fruiting, is a decided advantage if the pear is to be used as an intercrop with other fruit. It is preferable to double-work most varieties when grafting them on quince. The principal acreage planted with this stock is in the San Francisco Bay district.

Extensive projects for developing a satisfactory pear stock that is resistant to blight have been under way for some years. At the Southern Oregon Experiment Station, Medford, Oreg., trees of French-seedling origin have been selected that produce largely blight-resistant progeny. Some orchards have been established in which these seedling roots are used as the stock. A blight-resistant variety, generally Old Home, has been worked on these to form the trunk and framework. The desired top variety is then budded or grafted on Old Home. Such orchards are expensive to develop and their ultimate performance has not been determined. In some of them "incompatibility" is developing.

ORCHARD CULTURE AND COVER CROPS

In the northern sections, particularly Wenatchee and Yakima, Wash., and Hood River, Oreg., where an abundance of water for irrigation is available, pear orchards are largely maintained in a semipermanent cover crop or sod. Alfalfa or sweetclover is seeded between the trees, preferably before they begin to bear. The crop is allowed to grow throughout the season, matting down to form a dense soil cover during the late summer. The usual practice is to disk such orchards in the spring, working the ground thoroughly to incorporate the vegetation from the cover crop in the soil. Then furrows are opened for the summer irrigation, unless the orchard is irrigated with sprinklers. The disking holds the growth of the cover crop in check during the period in the spring when the trees bloom and grow most rapidly. After the disking, however, the cover crop soon begins to grow, and a heavy soil cover is obtained by midsummer. In many older orchards much of the alfalfa or sweetclover stand has been lost

and has been replaced by grasses or weed vegetation.

This system of orchard management entails the minimum cost for cultivation and provides a steady supply of organic matter for the soil. The soil is shaded and cooler throughout the season with the cover crop than with clean cultivation. The incorporation of organic matter, minimum cultivation, and penetration of the roots of the cover crop all aid in keeping the soil in satisfactory condition to take up the water readily.

Sweetclover has apparently been slightly superior to alfalfa in opening up impervious soil, probably because it is a deep-rooted biennial. The dying and decay of the roots at the end of the second season's growth tend to open up impervious subsoils to an unusual extent. However, the top growth of sweetclover is so vigorous and upright that it may require dragging down to facilitate other orchard operations.

In sections having less abundant water supply, the use of semipermanent cover crops in the orchard has not become general. In the Rogue River Valley section of Oregon and in practically all sections of California, clean culture throughout the summer months is practiced. The orchards are usually disked in the spring, and the soil is worked down thoroughly. Shallow cultivation is usually given to the land after each irrigation.

For soils of rather heavy texture the time for spring cultivation is particularly important, especially in nonirrigated orchards. If such soil is worked before it dries sufficiently, it will form into hard clods and remain in poor physical condition throughout the summer. If the soil is too dry, it is also difficult to pulverize it satisfactorily. If winter and spring cover crops are growing in nonirrigated orchards, it is particularly important to work them down before the soil has become too dry.

In sections where permanent cover crops are not used, seeding annual overwinter crops late in the summer is common. Among those most widely used are vetch, horsebeans, native legumes, and grain. In many orchards cover crops are not seeded, but an abundance of native vegetation develops in the fall after cultivation has been discontinued. This native vegetation is very helpful in maintaining the organic supply in the orchards. In most parts of California growth of cover crops or of native vegetation will occur during the winter months. In the northern sections there is not much growth of cover crops, except in the fall and early spring, because the winters are too severe.

FERTILIZATION

In most sections of the Pacific coast pears, in common with most orchard fruits, respond best to nitrogenous fertilizers. In practically all sections of Oregon and Washington and in some parts of California annual applications of fertilizers high in nitrogen stimulate tree growth and improve production. On some of the deep, fertile, alluvial soils, particularly where the orchards are under summer cultivation, little response from fertilizers has been obtained. Where fertilizers have proved of value, those high in nitrogen have generally been best. Annual moderate applications, usually made late in the fall, have proved very satisfactory.

In many western soils, particularly if slightly alkaline, zinc is not

supplied in sufficient amounts to meet the needs of the trees. Zinc deficiency causes the condition known as "little leaf," or "rosette." Leaves are small, light colored, and tend to develop in small clusters or "rosettes." Zinc deficiency in an orchard can be largely corrected by spraying the trees with zinc sulfate solution just before the buds break in the spring. Enough of the zinc is taken into the trees through small openings in the bark, pruning wounds, or leaf or fruit scars to supply their needs. Zinc applied to such soils is generally unavailable to the trees, being largely tied up or "fixed" in the surface.

In some orchards boron deficiency may also be a problem. Pears, especially in soils that are heavy and wet in spring, may develop a condition called blossom blast. Flower clusters do not develop properly and fail to set much fruit. This condition is apparently caused by failure of the tree to absorb and move into the blossoms sufficient boron for their development. It can be corrected by spraying the trees with a boron-containing material such as borax after the leaves have started to grow and the flower buds have separated in the cluster. Enough boron will be absorbed through these tissues to remedy the deficiency.

Iron deficiency is also common in pear orchards, particularly if the soils are alkaline. It causes a lack of green color in the leaves. They become white or "chlorotic." In severe cases this has been partially corrected by boring holes in the trunk and inserting gelatin capsules containing soluble iron salts, such as iron citrate. Recently good results have been obtained by spraying the trees with "chelated" iron, i. e., iron combined with organic materials that keep it from becoming insoluble. Growers having chlorotic trees should consult their county agent for the latest advice on treatment.

Maintaining a high level of organic matter in soils is important in reducing both zinc and iron deficiencies.

In most soils in the Pacific Coast States potassium, phosphorus, calcium, and magnesium appear to be amply supplied for the needs of pear trees. Thus the fertilization problems are mainly concerned with supplying nitrogen and, in special cases, zinc, boron, and iron.

IRRIGATION

Supplying water to the trees is one of the most important operations in successful pear growing. If the orchard becomes so dry that the rate of fruit growth is reduced during the growing season, final size of the fruit and total tonnage will be reduced in proportion to the length and severity of the water shortage. On the other hand, use of excessive water may lead to difficulty. Poorly drained soils may become waterlogged and injure roots. Because water must be pumped and is expensive in many pear districts, it should not be wasted.

Three methods of applying water are used in pear orchards. In California on fairly level land of medium or heavier texture, the flooding or basin method is largely used. Small dikes are thrown up as necessary to enclose an area of approximately level land. They should be small enough so that water can be applied rapidly from the available supply. These basins are then filled with water sufficient to restore soil moisture to the desired depth. Generally 6 to 8 acre-inches will be supplied per irriga-

tion. This method wets all the soil uniformly.

On moderately sloping land the rill or furrow method is generally used. Four or five furrows, equally spaced in the center between each tree row, are opened. Water from a head ditch or pipeline is run into these furrows at such a rate that it will be taken into the soil within the length of the furrow. Furrows must have only a moderate fall—generally 4 to 6 inches per 100 feet—to avoid erosion and to obtain even, moderately uniform infiltration. In light-textured soils often the whole root zone will not be wet from furrows. In the tree row, particularly, an area of dry soil remains. Also with furrows it is difficult to supply a uniform quantity of water along the length of the furrow. Frequently excess water may accumulate at the lower end of the furrow, or sometimes insufficient water may reach the lower end. Skill and care are essential for uniform application of water from furrows.

A third method of application is through the use of sprinklers. Lightweight aluminum pipe, with rapid coupling devices, is used in many pear orchards, especially where the soil is fairly steep or very open so that water enters it rapidly. By sprinkling, all the soil is wet and response of the trees has been very good, particularly on sites where uniform distribution of water by furrows or basins is difficult. Equipment for sprinkler irrigation is expensive, but improved water distribution and tree response are justifying its use in many orchards.

The amount of water required by pear trees will vary with the temperature and humidity and with the size and leaf area of the trees. Only a small amount of water is used before the bloom season, since there is little foliage on the trees. Use of water increases as the foliage develops and as the days become hotter and generally drier.

In the interior valleys of the Pacific Coast States vigorous mature pear trees will use from 5 to 6 acre-inches of water per month in July and August and a little less in June and September. Since some water is lost from evaporation and other causes when irrigating, about 7 inches per month may need to be applied in July and August. On deep soils of good water-holding capacity, this amount can be applied in one irrigation, and irrigating monthly will be satisfactory. In soils that are shallow or coarse textured, more frequent and lighter watering should be practiced.

POLLINATION

Cross-pollination aids in the setting of fruit by all important pear varieties under some if not all conditions in the Pacific Coast States. In some orchards, especially in the Sacramento Valley section and near Clear Lake, Calif., good crops of fruit are harvested in large Bartlett orchards where no provision is made for cross-pollination. However, many growers believe that heavier crops could be obtained in some years with pollination. Provision for cross-pollination should be made even though such varieties as the Bartlett and Anjou may, under favorable conditions, set adequate crops when planted alone.

In providing for cross-pollination the interplanting of commercial varieties in alternate rows is often practiced. If a greater number of trees of one variety than of another is desired, up to four rows of one may be planted to each row of the pollinizer. Also single pollinizers may be planted at intervals throughout the orchard. One tree

is considered sufficient to pollinize eight others if bees are provided to carry the pollen, every third tree of every third row being a pollinizer. Another method is to top-graft a branch of the tree with scions from a pollinizer. This method is practiced when a solid block of one variety has been planted and the grower does not wish to remove trees to make room for planting others as pollinizers. It is less desirable than interplanting, as the fruit of the individual branch will need to be harvested separately and may need other special handling.

Results obtained in California[3] indicate that the Bartlett is a satisfactory pollinizer for most of the other important varieties, including the Anjou, Bosc, Comice, Hardy, Howell, Easter Beurre, and Winter Nelis; that in the Sierra Nevada foothills the Bartlett is almost entirely self-sterile; and that the Winter Nelis is a good pollinizer for the Bartlett. Tests made in the Hood River Valley demonstrate the desirability of cross-pollination for the Anjou under the conditions there. The Bartlett and Easter Beurre were found to be effective pollinizers for the Anjou.

PRUNING

Pruning is an important operation in the regular production of large pears typical of the variety in shape and quality. It is also one of the most difficult problems confronting the grower. The growth condition and the differences in characteristics of growth and production among varieties all determine the type of pruning in a given orchard. A careful study of varietal characteristics and the effect of local conditions and treatments on them is necessary in evolving the best pruning system.

PRUNING YOUNG TREES

In a new orchard the problem of shaping the tree and protecting the trunk and branches from the sun is encountered. It is desirable to obtain a good distribution of branches along the main trunk. If the nursery tree being planted is an unbranched whip, cut off the tree at the height desired for the topmost main branch, usually 40 to 48 inches. With vigorous trees a large number of branches will form along the trunk the first season.

In pruning at the end of the first year, 4 or 5 vigorous branches 6 to 12 inches apart along the trunk and well distributed around it should be selected for the main scaffold branches, and the other limbs should be removed. It is preferable that the central branch be somewhat stronger than the lower branches, as it forms the leader of the tree, and stronger crotches result if the side branches are smaller than the trunk from which they arise. Unless the tree has made excessive growth, no heading back of these branches is necessary. Such a distribution of branches gives a stronger tree and reduces the danger of sunburn injury (fig. 9) and of blight to the tree as a whole.

After the first season and until the tree bears, the pruning will vary somewhat with the tree's growth. The less pruning, the more quickly the tree will bear. Consequently, once the main branches are selected, a minimum of pruning will suffice until the tree bears. If the growth is very strong, heading back the branches lightly for a year or two will give a more compact tree that will stand more stiffly in the wind. Heading back should generally be

[3] Calif. Agr. Expt. Sta. Bul. 373, Pear Pollination.

34076-P

FIGURE 9.—High-headed Bartlett pear tree, which was injured by sunburn and sunscald after freezing weather, showing bridge grafting of the sunscald injuries, Vancouver, Wash. (Photographed in August.)

avoided from the second year until the tree is bearing heavily.

With varieties susceptible to blight and where blight is likely to be serious, it is advisable to leave more framework and secondary branches, as some of these branches may have to be removed if they become infected with this disease.

As the trees approach bearing age, corrective pruning may be necessary to obtain a satisfactory fruiting condition. Most young trees grow upright and do not branch freely. Admitting light to the center of the tree encourages early production. An effective means of spreading the trees mechanically for this purpose is to bend down and tie the branches either to the trunk or to stakes driven into the ground. These branches will develop numerous twigs and spurs and generally will become fruitful. In addition, spreaders may be placed between the branches to hold them apart, and some of the branches that are too close together should be thinned out. Once the tree is bearing heavily, the weight of the fruit is usually sufficient to keep it satisfactorily spread.

PRUNING BEARING TREES

After the tree is bearing fully, the purpose of pruning is to maintain the fruiting wood in vigorous condition in order that the tree may produce regular crops of fruit of good size and quality. To obtain such crops the fruiting spurs should be kept vigorous. Pruning reduces the number of fruiting points but stimulates more vigorous growth of those that remain. In general, the minimum pruning that will maintain the spurs and fruiting wood in vigorous growing condition will give the best results. Pruning practices for the bearing tree should be closely correlated with soil-management practices, including irrigation, fertilization, and cultivation, and with the thinning of the fruit crop.

Pear varieties fall into two general groups according to their bearing and growth habits. One group has a strong tendency to develop and retain spurs throughout the tree. Little new growth is produced except at the terminals of the branches and near points of pruning. The Hardy represents the extreme of this growth habit. Other varieties having this tendency, though less pronounced, include the

Bosc, Clairgeau, Flemish Beauty, and to a still less extent, the Anjou and Comice.

The trees in this group require rather heavy and detailed pruning to keep the spurs in a vigorous, fruitful condition. The heading back of branches and new shoots to maintain the vigor of the fruiting branches and to induce growth of new branches is essential, as well as the thinning out of old fruiting branches and spurs to maintain the vigor of those that are left.

Varieties in the other group tend to produce twigs and vigorous shoots not only from the terminals of the branches but along the sides of the branches as well if conditions are favorable for wood growth. Development of spurs is much less marked. The Bartlett and Winter Nelis are outstanding examples of varieties having this growth habit, as well as the P. Barry, Glou Morceau, Forelle, and Easter Beurre. In this second group the shoots must be thinned in order to keep the trees sufficiently opened to the light and to maintain sufficient vigor in the new growth.

Moderate annual pruning of practically all bearing varieties seems desirable to keep the trees in the best fruiting condition. In general, pruning of pear trees should be detailed and distributed over the whole tree, as the greatest response in increased vigor comes in the part of the tree adjacent to the pruning cuts.

In all sections where blight is a serious menace the danger of inducing a vigorous growth that will be very susceptible to blight must be considered. Only the heading back and the thinning out necessary to enable the tree to make a moderately thrifty growth and produce fruit of the desired size should be undertaken; unnecessary cutting that will result in a heavy new growth should be avoided. In general, the wood of the pear tree remains vigorous and will withstand abuse in pruning or endure neglect at pruning time with less permanent injury than will that of many other fruit trees.

FRUIT THINNING

Many varieties of pears set heavy crops, which do not develop to good marketable size, particularly the Winter Nelis, Bosc, and Bartlett. If medium-sized to large fruit is desired, part of the crop from such trees should be thinned in order to have a larger leaf area per fruit. In California thinning of the Bartlett is seldom necessary.

Many pear varieties, such as the Bartlett, Hardy, and Bosc, tend to set the fruit in clusters, often 3 to 5 fruits on a single spur. If the set of fruit on the tree as a whole is excessive, these clusters should be reduced to 1 or 2 fruits each by removal of the smaller ones. On the other hand, if the set of fruit on the tree as a whole is not excessive, fruit in these clusters will reach satisfactory size and quality without thinning.

It is impossible to lay down hard-and-fast rules for the thinning of pears. The number of fruits a tree will develop to good marketable size will vary with its vigor and with the growing conditions. Experiments indicate that with nearly all varieties 30 to 40 good leaves per fruit are essential for the building of the materials that go to make the fruit. However, these leaves need not be directly adjacent to the fruit. With extremely heavy sets of fruit, thinning to reduce the amount of fruit in proportion to the leaf system is essential if fruit of best size

and quality is to be obtained. Since fruit that is small at thinning time tends to remain so, it should be removed at that time.

As the natural drop is usually over about 6 weeks after bloom, the earlier the thinning is done after this, the greater is the effect on improving the size of the remaining fruit.

Under present standards larger fruit is required for canning than for the fresh-fruit market. If the crop is intended primarily for canning, it is essential that fruit of good size be obtained.

USE OF HORMONE SPRAYS TO PREVENT FRUIT DROP

Dropping of fruit before or during harvest causes considerable loss in some years. This loss can be greatly reduced by the use of hormone sprays on some varieties, including the Bartlett and Bosc.

Such sprays are now used generally by commercial pear growers. α–Naphthalene-acetic acid has been effective for this purpose when used at a strength of 5 parts per million at the beginning of the harvest drop. A less expensive material, 2,4–D,[4] is also effective. Concentrations of 2,4–D as low as 2.5 parts per million largely prevent fruit drop. At concentrations higher than 5 parts per million, 2,4–D causes considerable injury. When these materials are used to prevent the natural drop of fruit, it is important that the fruit be harvested at the proper stage of maturity; it should not be allowed to remain on the tree too long. Overripe pears, particularly those of the Bartlett variety, break down soon after harvest.

PEAR HANDLING AND STORAGE

Since pears, both for fresh-fruit shipment and for canning, are harvested prior to becoming tree ripe, the stage of maturity at which they are picked is very important. If they are harvested too early, the quality is poor; if they are allowed to become too mature on the tree, the storage life is shortened and many varieties tend to break down at the core while still sound at the surface. Numerous investigations have been conducted to determine the proper picking maturity of pears and the best methods of handling after harvest.[5] County agents or State Department of Agriculture inspectors in the different areas are glad to assist growers in determining when to pick.

INSECTS AND DISEASES

Several insect pests and diseases cause serious losses in commercial pear orchards in the Pacific Coast States. The principal destructive insects are the pear psylla, pear leaf blister mite, codling moth, pear thrips, and mites. Blight, scab, and black end are the most serious diseases. Familiarity with the performance of the insect or disease in the locality where the orchard is situated is necessary. Successful

[4] 2,4–Dichlorophenoxyacetic acid.

[5] U. S. Dept. Agr. Tech. Bul. 140, Investigations on the Handling of Bartlett Pears From Pacific Coast Districts, and 290, Investigations on Harvesting and Handling Fall and Winter Pears; Calif. Agr. Expt. Sta. Bul. 470, Maturity Standards for Harvesting Bartlett Pears for Eastern Shipment; Oreg. Agr. Expt. Sta. Bul. 228, Investigations on the Harvesting and Handling of Bosc Pears From the Rogue River Valley, and 254, Further Investigations on the Harvesting, Storing, and Ripening of Pears From Rogue River Valley. They may be consulted in libraries.

control depends on the precision used in choosing the time for the application of control measures, as well as on the thoroughness of applying the remedy. The State agricultural college or county agricultural agents should be consulted for specific instructions as to control practices in the various districts.

INSECTS [6]

Pear Psylla [7]

The pear psylla, now widely distributed in the Western States, secretes honeydew that runs down over the foliage and fruit. A sooty fungus grows in the honeydew, causing the skin of the fruit to become scarred and blackened and brown spots to appear on the foliage.

Control can be obtained by spraying at the delayed-dormant or green-tip stage of bud development with 2-percent oil emulsion and during the summer with a 25-percent wettable-powder formulation of 1 pound of parathion, 1 pound of EPN, or 2 pounds of malathion per 100 gallons of water. Complete this spray program not later than 14 days before harvest if you use parathion or EPN and 7 days before harvest if you use malathion. Local authorities can tell you when the summer applications should be made. One postharvest application is sometimes necessary.

Pear Leaf Blister Mite [8]

The pear leaf blister mite is a minute pest that lives in the buds, foliage, and fruit of pear trees. It produces small galls or blisters on the leaves.

Control is obtained by spraying with liquid lime sulfur, diluted to test 3½° Baumé, late in the fall when the mites are migrating from leaves to buds or late in the dormant season just as the buds are swelling. A 3-percent oil-emulsion spray applied as the buds are swelling is also effective.

Codling Moth [9]

The codling moth is an important pest in all pear-growing areas of the Pacific Coast States. The worm, or larva, causes injury. It bores into and tunnels in the fruit, reducing its value or destroying it. There are two or more distinct broods of the codling moth each year.

For control, 2 to 4 cover sprays of 2 pounds of 50-percent DDT wettable powder per 100 gallons of water are most commonly applied, the last not later than 30 days before harvest. Three pounds of lead arsenate or 3 pounds of 50-percent methoxychlor wettable powder per 100 gallons of water may also be used, the former not later than 40 days and the latter not later than 14 days before harvest. Consult local authorities for the dates for applying sprays, as they vary from one area to another.

Pear Thrips [10]

Pear thrips are very destructive insects that injure the opening blossom clusters and blossoms.

They may be controlled by spraying with 2 pounds of a 50-percent DDT wettable powder in 100 gallons of water when about 50 percent of the buds are in the green-tip stage. A dust containing 5 percent of DDT with sulfur or inert materials may be used if preferred.

[6] Prepared by B. A. Porter, entomologist, Entomology Research Division.
[7] *Psylla pyricola* Foerst.
[8] *Eriophyes pyri* (Pgst.).
[9] *Carpocapsa pomonella* (L.).
[10] *Taeniothrips inconsequens* (Uzel).

Mites[11]

Several species of mites, or red spiders, often cause much injury to pear leaves. They feed by sucking out the contents of the leaf cells, causing a whitening or mottling of the leaves, which finally become browned or bronzed. They are most likely to be injurious in the nonirrigated orchards in hot, dry areas.

The eggs of certain species of these mites may be destroyed with a dormant-strength oil emulsion applied late in the winter when the buds begin to swell. All the species may be controlled when they appear on the foliage with parathion, EPN, malathion, Aramite, or demeton, the quantity depending on the species of mite present and whether a preventive or suppressive program is followed. Aramite is effective against strains of mites that are resistant to phosphorus insecticides and demeton is effective against most of them. R–242, or Sulphenone, is superior to Aramite if the clover mite is a problem, and TEPP is suggested if applications are needed near harvest. The insecticides for mite control may be added to the DDT applied for control of the codling moth, or they may be used alone. Two applications are usually necessary. Local authorities can advise when they should be made and at what strength. Follow all recommendations and precautions on the label, especially if you use parathion, EPN, demeton, or TEPP.

PRECAUTIONS

Insecticides are poisonous to man and animals and should be handled accordingly. Follow recommendations and observe all precautions for storing and handling them. Parathion, EPN, demeton, and TEPP are extremely poisonous. Do not use them unless you read and follow the directions furnished with them. To avoid excessive harvest residues, refer to the label on the products as to the time of application.

DISEASES

Blight

Blight, caused by a bacterium,[12] is by far the most destructive disease that attacks pears. It is prevalent in most of the important pear-growing sections of the Pacific Coast States.

The disease usually appears first as a blossom blight and spreads later to shoots. Blighted blossoms and the leaves of blighted shoots turn brown and then black and remain attached to the tree. From blighted blossoms and shoots the disease-producing bacteria may enter the trunk and main limb, causing cankers in which they may overwinter and act as a source of infection for the next season.

Usually control consists of the removal of all infected spurs and branches as soon as they appear and of the removal of affected areas on the large branches, crotches, trunks, and roots during the dormant season. In all this work cutting tools should be disinfected so as to prevent transmitting the disease. Where blight is a menace, weekly visits to every tree should be made during the spring and summer by someone experienced in blight control. Helpful preventive measures consist in removing all root suckers and succulent water sprouts on the body of the tree in the fall or winter and employing cultural and pruning practices that oppose vigorous wood growth.

A chemical solution containing zinc chloride, which penetrates the

[11] *Tetranychus* spp., *Metatetranychus ulmi* (Koch), and *Bryobia praetiosa* Koch.

[12] *Erwinia amylovora* (Burr.) Winslow et al.

tissues and kills the bacteria, is recommended in some States as a substitute for canker removal.

It is desirable in sections where blight causes losses every year to apply special blight-control sprays early in the season. Copper compounds have been effective for this purpose, but they may cause fruit russet under some conditions. This injury can be reduced to the minimum by using dilute sprays or special dust formulations, so that the amount of metallic copper applied per acre per application does not exceed 1 pound. Bordeaux mixture (½–½–100), or its equivalent in other copper compounds, applied at the rate of 800 gallons per acre meets this requirement. Copper-lime dust containing not more than 3.5 percent of metallic copper is also satisfactory, provided not more than 40 pounds of dust is applied per acre.

Streptomycin, an antibiotic, or a mixture of it with a small quantity of terramycin has given promising blight control. These materials should be applied when 25 to 30 percent of the blossoms are open, and the applications should be repeated at intervals of 7 days during the critical blight-infection period.

The amount of active ingredient varies in the different commercial antibiotic preparations. State agricultural colleges and county agricultural agents should be consulted regularly regarding the use of antibiotic sprays and other modern blight-control procedures.

Scab

Scab[13] is a fungus disease that appears as dark moldy patches on the twigs, leaves, and fruit. It often causes heavy reduction in yield and serious defoliation in sections having considerable spring rainfall.

[13] Caused by *Venturia pyrina* Aderh.

The disease can be controlled by the following series of fungicidal sprays:

(1) *Delayed-dormant* or green-tip spray.—Use 6 to 8 gallons of liquid lime sulfur (32° Baumé), or its equivalent, in 100 gallons of water.

(2) *Pink* or preblossom spray.—Use ferbam or ziram (1½ pounds in 100 gallons of water), and apply the spray when the individual unopened blossoms are well separated in the blossom clusters.

(3) *Petal-fall* or calyx spray.—Use ferbam or ziram (1½ pounds in 100 gallons of water), and apply the spray immediately after the blossom petals have dropped.

(4) *Cover sprays.*—Additional sprays of ferbam or ziram at the rate used in the pink and petal-fall applications should be applied at intervals of 15 to 20 days. The number of cover sprays needed depends on the prevalence of rainy weather.

For detailed instructions on spraying specific varieties in any given locality, consult the State agricultural college or the United States Department of Agriculture.

Black End

Black end makes fruits hard, rounded, or often black over the blossom end as they approach maturity. It occurs almost exclusively on trees propagated on oriental stock (p. 14).

No satisfactory control measure has been found, but the disease may be avoided by using French pear seedlings as rootstocks.

Stony Pit

Stony pit is a virus disease that causes circular or irregular pits on the fruit. The flesh near these pits is hard and stonelike. Badly affected pears are dwarfed and misshapen. The disease is prevalent on

the Bosc and occurs to a lesser degree on the Anjou and other varieties. The Bartlett, however, is not visibly affected by it.

No specific control measures are known, but the Bartlett is frequently topworked on stony pit-affected trees to prevent loss from this disease. The stony pit virus is transmitted in budwood, and buds for the propagation of susceptible varieties should be selected only from trees known to be free of stony pit symptoms.

PRINCIPAL PEAR VARIETIES IN THE PACIFIC COAST STATES

ANJOU

The Anjou, a large green pear of French origin, has been grown in the Pacific Coast States over a long period, but most plantings have been made during the last 35 years. It is the most important winter pear and second only to the Bartlett in total production. The Anjou is grown mainly in Washington and Oregon, with limited plantings in California.

The fruit is attractive and high in dessert quality. It keeps well in storage until March or April and may be marketed over a long period. The entire commercial crop is marketed as fresh fruit. The tree is vigorous, grows large (fig. 7), and is the most resistant to blight of any of the large high-quality varieties. It is a consistent bearer but a slow producer. Rather heavy and detailed pruning improves fruit set on older trees.

BARTLETT

The Bartlett is grown on almost three-fourths of the pear acreage of the Pacific Coast States. Nearly two-thirds of the crop is canned and about one-third is sold as fresh fruit, being shipped to all parts of the United States. Small quantities are dried.

The trees are adapted to a wide geographical range and to a great diversity of soil and climatic conditions. They are prolific, bear regularly, and endure neglect, abuse, and uncongenial surroundings surprisingly well. These characteristics, combined with the quality and uses of the fruit, make the Bartlett a remarkable fruit.

When well grown the Bartlett is generally considered the standard of excellence by which other pears for fresh-fruit shipment are measured. It is the only variety in the West to be used for all purposes. In flavor and texture it is unsurpassed among the large commercially grown pears in the Pacific Coast States. It is the first of the important commercial varieties to ripen, the picking season ranging from early July in the valleys of central California to late August at the high elevations in California and in the northern sections.

The fruit may be held successfully up to 2 months in cold storage. It is normally off the fresh-fruit markets by the middle of October. The Bartlett is best both in dessert and in storage and handling qualities when grown under fairly hot summer conditions. In the coastal sections of all the Pacific Coast States, where summers are very cool, the fruit does not keep so well after harvest as in the hotter interior sections and usually is less rich in flavor. Fruit from these coastal sections is usually canned or used locally, as the carrying quality

is not sufficiently good to allow shipment to distant markets.

BOSC

The Bosc is grown on about 3,000 acres, mainly in the Rogue River Valley of Oregon, where the fruit is excellent.

The fruit grows to good size, and the yellow skin, which is almost covered with a brown russet, is particularly attractive. It is a fall and early-winter fruit, reaching prime market condition in October and November. The tree bears rather early and produces regular heavy crops.

The tree, particularly while young, is difficult for the pruner to manage. The branches produce vigorous new shoots from their terminals. These remain rather slender for a considerable time and branch but little, so that the tree remains open and often becomes ungainly and willowy by the spreading of the slender branches. Special attention is required to maintain a tree of desirable shape.

Trees of this variety are attacked by blight about as seriously as those of any other commercial variety. The fruit may be seriously affected by stony pit virus (see p. 25). The tree is less tolerant of poor soil drainage than many other varieties.

COMICE

In the Santa Clara Valley of California and the Rogue River Valley of southern Oregon, the Comice is grown on nearly 2,000 acres. This tree is open and rather easily managed by the pruner, but it is not so consistent in bearing habits as many other varieties, often setting very light crops.

The fruit is large, light greenish yellow, and of excellent dessert quality. In flavor it is among the very best of the pears. It keeps well if handled carefully and can be held in cold storage into January. However, it is one of the most easily bruised of the commercial varieties. The skin is tender and easily punctured, and even light bruises at picking time will result in darkened areas on the fruit. It is also readily injured by the rubbing of leaves and branches. In recent years much of the crop has been marketed for gift packages and other channels where special handling can be given.

HARDY

The Hardy is grown on some 2,000 acres, mainly near San Francisco Bay and in the Santa Clara and San Juan Valleys in California. The tree grows well, is a heavy bearer, and appears to be more resistant to blight than the Bartlett. It is rather easily handled by the pruner, because it is not inclined to branch freely and remains open. Much of the new growth takes place at the terminals of fruiting branches or where branches are headed back or removed. Numerous large fruiting spurs instead of shoots develop along the fruiting branches and remain vigorous and productive for many years (fig. 10). The wood unites well with quince and is frequently budded on quince roots, then topworked to other varieties.

The fruit is of good size and shape, keeps and handles fairly well in storage, and attains an attractive flavor. It ripens soon after the Bartlett and before the Bosc and the Anjou. It was a favorite for export prior to World War II, but now it is largely used in canned-fruit mixes and baby foods.

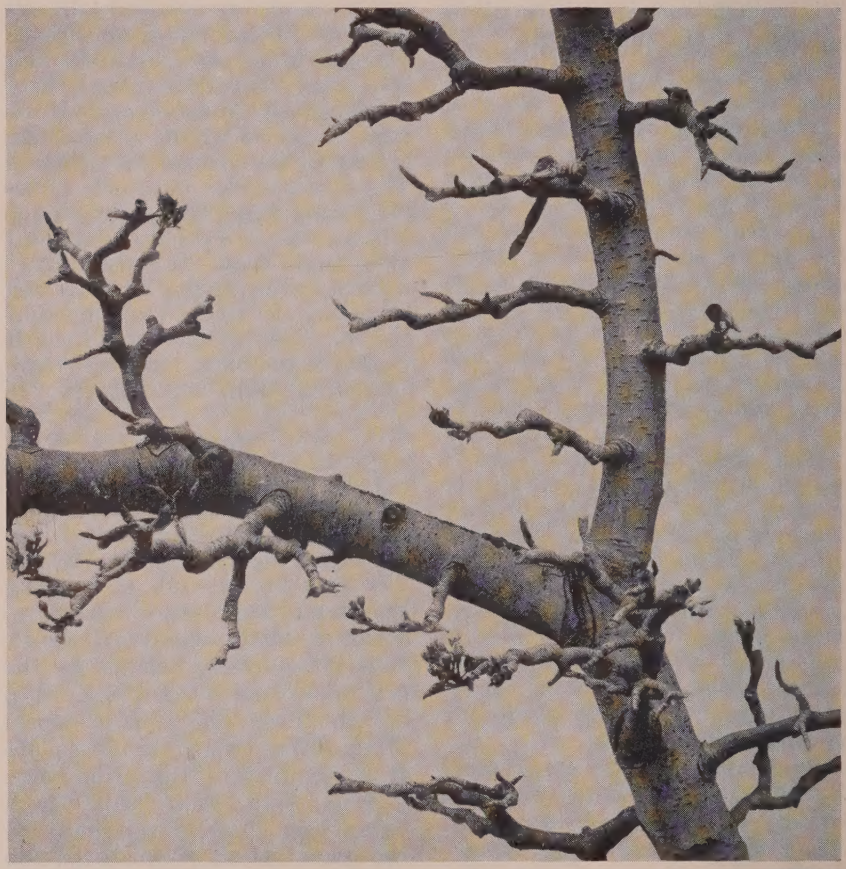

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FIGURE 10.—Some 12-year-old spurs on secondary branches of a Hardy pear tree on quince roots, growing in deep, fertile, irrigated soil, Santa Clara, Calif. (Photographed in April.)

MINOR VARIETIES

CLAIRGEAU

The Clairgeau is planted but little at present, as the fruit, although large and attractive, is coarse in texture and second rate in flavor. It has a storage season of only 2 or 3 months. Clairgeau trees are found in a number of older orchards in the San Francisco Bay district and in other districts in the cooler seacoast valleys of California. The tree grows well, is productive, and is one of the easiest trees to prune.

EASTER BEURRE

Among the pear varieties grown on the Pacific slope, the Easter Beurre is one of the latest to ripen. The trees are heavy producers, and the fruit keeps and handles very well, holding until May in cold storage if carefully handled. For

these reasons the variety is retained. The coarseness of the fruit and the rather unattractive green color, which is often patched with russet, prevent extensive planting. The fruit is large and is prized for baking. The tree also grows large and is more resistant to blight than most other varieties. The Easter Beurre is sometimes used as a pollinizer.

FORELLE

The Forelle is a late-fall variety, which is grown only sparingly because of its susceptibility to blight. It is less resistant than other commonly grown varieties. Limited plantings in the rather cool Santa Clara Valley of California and the Hood River Valley of Oregon, where blight is not a serious menace, have proved satisfactory. Although the trees do not grow large, they bear regularly and well. The speckled fruit with its greenish-yellow skin and brilliant red cheek is very attractive. It is juicy and has a pleasing flavor.

GLOU MORCEAU

In the coastal districts of central California the Glou Morceau is still grown to some extent, but it is seldom planted. Its cold-storage season extends until early spring. The tree grows well. The smooth greenish-yellow fruit is not particularly attractive, but it is juicy, of a smooth, tender texture, and of good flavor. Deformed fruits of this variety are common, and in some years large quantities are thrown out as culls.

WILDER EARLY

Fruit of the Wilder Early is ready for shipment about 2 weeks to a month before that of the Bartlett and is one of the best of the very early pears. The fruit is small, but the red cheek and yellow skin make it attractive. The tree grows rather slowly and remains open, as there is little branching. It has a decided tendency to biennial bearing, producing excessive crops one year and remaining almost fruitless the next. The Wilder Early is not grown much but is found occasionally in the warmer pear-growing valleys of California.

WINTER NELIS

The Winter Nelis was formerly widely distributed on the Pacific coast, but the acreage has declined until it is now of minor importance. It is grown to some extent in the Santa Clara Valley of California, the Rogue River Valley of Oregon, and the Yakima Valley of Washington.

The fruit is rather small, but it is attractive with its greenish-yellow color and large areas of heavy dark-brown russet, which sometimes entirely cover the fruit. It is tender, juicy, and of good flavor. It stores well, holding until late spring in cold storage.

The tree presents a difficult problem to the pruner, because the young shoots, which make a thrifty growth, tend to droop and become tangled. The tree grows large and sets fruit heavily. To produce fruit of marketable size, the tree requires good soil and it needs to be well pruned and the fruit thinned. In its resistance to blight the Winter Nelis is slightly superior to the Bartlett.

FUTURE OF PEAR GROWING IN THE PACIFIC COAST STATES

The high quality of the fruit and heavy, dependable production assure the permanency of the pear industry in the Pacific Coast States. The pear acreage increased rapidly between 1920–30. Since then a considerable number of orchards on unsuitable soils or with unsatisfactory rootstocks have been pulled up. As much of the recent planting is on land well suited for the purpose, the present annual production probably will be maintained for many years. Pear orchards if well located and well cared for are long lived. Many orchards more than 50 years old are still producing large crops of high-quality fruit.

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